"Sun-spots and Terrestrial Phenomena. I. On the Variations of the Daily Range of Atmospheric Temperature, as recorded at the Colaba Observatory, Bombay." By CHARLES CHAMBERS, F.R.S., Superintendent. Received May 30. Read June 15, 1882.

The present investigation is on the model of one by Dr. Balfour Stewart, published in the "Proc. Roy. Soc." (vol. 25, p. 577), and dealing with similar records obtained at the Kew Observatory. The records extend, in the present case, from June 1, 1847, to December 31, 1880, and consist of excesses of the highest temperature observed above the lowest temperature observed on every observation day of the period, and all are therefore necessarily positive numbers. Until the end of the year 1851, the observation day was the Göttingen Astronomical day: since that time it has been the Bombay Civil day. The daily excesses were obtained for the period from 1847·42 to 1873·0, from hourly observations made on all days except Sundays and a few holidays, and for the period from 1873·0 to 1881·0 from daily readings of self-registering maximum and minimum thermometers taken on all days without exception; for all days previous to 1866·0 they are differences of uncorrected readings of the dry-bulb thermometer, but for all later days every individual thermometer reading was corrected for the error of graduation of the thermometer before the differences were taken. The maximum thermometer is a mercurial one of the construction known as Negretti and Zambra's: the minimum is a spirit thermometer, of which the chamber at the top of the tube is bent upward, so as to prevent the accumulation in it of condensed spirit; the instrument was tested in 1865, and again in 1881, and it was found on the latter occasion to have practically the same error as before. The dry bulbs (up to 1873·0) were mercurial thermometers by Newman, with scales divided to fifths of a degree.

A. *Annual Variation of Temperature-Range.*

B. *Variation of Long Period.*

2. Table I exhibits the monthly and annual means of the daily temperature-range.

Changes were made in the mode of exposure of the thermometers, of a character likely to affect the comparability of the preceding and following observations, in 1851 and again on 1866·0; but the annual means in the following table seem to imply that the state of things holding in 1851 was maintained for some time longer, and as the only event on record that would suggest a definite limit to that time is a change of thermometers on the 31st March, 1852, we have divided the

Table I.—Containing Monthly and Annual Means of Daily Temperature-Range expressed in Fahrenheit degrees.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean of year.
1847	...	...	...	...	...	8·1	7·3	8·2	8·7	12·2	15·4	16·2	
1848	17·6	15·4	13·8	11·4	10·7	8·2	7·4	6·8	9·5	11·0	15·4	15·3	11·9
1849	14·9	13·9	13·2	11·9	9·9	8·2	7·2	6·7	7·2	12·3	15·0	16·5	11·4
1850	14·9	18·2	13·1	11·7	10·3	9·9	8·2	8·1	9·0	11·9	15·9	15·3	12·2
1851	15·8	15·2	13·4	12·7	10·6	9·1	6·7	7·5	9·4	11·3	13·0	16·2	11·7
1852	16·0	14·8	14·1	13·2	11·8	9·3	7·5	7·2	8·0	11·1	15·2	12·9	11·8
1853	15·8	15·0	14·7	12·6	11·9	8·5	6·5	8·5	8·3	13·1	14·3	16·1	12·1
1854	15·4	15·9	14·4	12·4	11·5	9·2	6·5	7·9	8·3	11·5	13·1	12·1	11·5
1855	13·8	12·6	12·8	12·2	11·5	9·0	7·6	9·0	9·2	11·2	13·9	14·1	11·4
1856	13·8	13·6	11·8	12·2	11·2	8·8	6·6	7·8	8·4	10·4	13·3	13·5	10·9
1857	12·6	14·8	14·1	12·2	10·8	9·7	7·4	5·4	7·3	11·2	13·2	14·9	11·1
1858	15·0	14·2	11·8	12·1	10·6	9·4	7·6	7·2	8·3	11·4	13·5	13·1	11·2
1859	13·8	12·9	13·5	11·9	10·3	9·0	8·0	6·8	8·3	10·2	12·7	14·0	10·9
1860	14·8	12·1	12·0	10·1	9·6	9·1	5·9	7·4	7·7	10·0	15·4	15·2	10·8
1861	14·3	15·3	12·5	11·3	10·7	8·8	5·6	5·4	8·1	9·4	13·6	14·1	10·8
1862	13·6	14·7	13·3	11·5	10·5	8·3	7·4	7·7	7·8	10·2	12·8	15·2	11·1
1863	14·6	16·5	11·8	11·5	10·6	7·4	7·0	6·7	8·4	11·0	14·0	13·9	11·1
1864	15·1	14·0	13·0	10·9	10·4	8·9	6·4	7·0	9·2	12·1	12·6	14·7	11·2
1865	14·6	13·3	12·6	11·3	10·2	9·5	7·0	6·3	9·2	11·1	13·6	12·5	10·9
1866	13·4	13·7	10·8	10·9	9·2	7·0	5·9	5·6	7·9	10·6	14·0	13·3	10·2
1867	13·0	13·7	11·6	9·5	8·7	7·3	6·0	5·6	6·8	10·0	12·3	13·2	9·8
1868	13·0	12·8	11·0	9·9	9·1	7·3	6·4	5·9	7·7	10·9	13·6	13·4	10·1
1869	13·0	12·4	10·6	10·0	9·2	7·3	6·3	6·1	6·6	9·5	12·1	10·6	9·5
1870	12·5	12·9	10·9	10·5	8·7	7·5	5·3	6·3	7·0	8·9	10·8	12·0	9·4
1871	12·8	12·4	11·7	10·2	8·6	7·5	6·5	5·9	6·9	10·4	11·1	11·9	9·7
1872	13·5	14·2	11·1	10·4	9·0	7·3	5·3	6·2	7·1	10·4	13·4	11·1	9·9
1873	13·6	11·4	10·3	9·4	8·6	6·5	4·8	5·8	7·0	11·2	12·3	13·8	9·6
1874	13·5	13·3	11·2	10·0	8·4	7·1	5·4	6·3	6·5	10·4	12·1	12·5	9·7
1875	13·4	11·6	11·0	10·0	8·9	7·2	6·7	6·4	6·1	10·1	12·4	12·6	9·7
1876	13·0	13·1	10·6	9·8	9·0	7·5	5·9	6·5	8·0	11·3	12·3	13·8	10·1
1877	12·3	12·0	11·5	10·6	9·3	8·1	7·4	7·2	8·4	8·8	12·3	10·9	9·9
1878	12·8	13·5	11·3	10·7	9·4	8·4	6·8	6·5	7·7	10·4	10·6	14·1	10·2
1879	14·1	12·6	12·6	10·6	9·0	7·2	7·0	6·0	7·8	10·4	13·8	15·3	10·5
1880	14·6	13·6	11·2	10·4	9·3	8·2	6·7	7·2	7·3	10·1	12·9	13·9	10·4
Means for groups of years.													
1848 to 1851 ...	15·8	15·7	13·4	11·9	10·4	8·8	7·4	7·3	8·8	11·6	14·8	15·8	11·8
1853 to 1865 ...	14·4	14·2	12·9	11·7	10·8	8·9	6·9	7·2	8·3	11·0	13·5	14·1	11·2
1866 to 1872 ...	13·0	13·2	11·1	10·2	8·9	7·3	6·0	5·9	7·1	10·1	12·5	12·2	9·8
1873 to 1880 ...	13·4	12·6	11·2	10·2	9·0	7·5	6·3	6·5	7·3	10·3	12·3	13·4	10·0

observations into distinct series at the times 1852·25 and 1866·0; and we have made a further division at 1873·0, because the records after that time are *absolute* ranges for the whole day, whilst those of the preceding years were derived from a register in which the intervals between the hourly observations were all blanks. The means at the foot of Table I are for all the full years of the periods thus separated to form distinct series of observations, and the general means for these periods may, in the absence of immediate comparability of the records of one period with those of another, and proceeding on a very rough hypothesis, be used to reduce the whole series of monthly mean ranges more nearly to a common scale, and thus to prepare them to exhibit, though very doubtfully yet perhaps in the least objectionable manner possible, any long-period variation with which they may be affected.

The rough hypothesis is that the general mean temperature-ranges of the full years of the several periods were really identical, and that the differences found are due to difference in the mode of exposure and in the fulness of the registers kept. This is, of course, objectionable on the ground that if there be a real variation of long-period, it will affect the general means of our four series of observations in different degrees, and any result that we arrive at must accordingly be received with caution; but, on the other hand, the probability of our finding a variation of definite character at all is thereby diminished, and if such a variation should still exhibit itself, it will be in spite of some tendency in our mode of procedure to obliterate it.

3. The general means for the four periods are 11°·8, 11°·2, 9°·8, and 10°·0. Choosing the last as a standard period, the others are reduced to its scale by multiplying the respective monthly mean ranges of Table I by $\frac{10\cdot 0}{11\cdot 8}$, $\frac{10\cdot 0}{11\cdot 2}$, and $\frac{10\cdot 0}{9\cdot 8}$: the values thus obtained, as well as the monthly and annual means—that is, the means of the several horizontal lines and vertical columns—are shown in Table Ia.

Table Ia.—Showing the Monthly and Annual Means of Daily Temperature-Range reduced to a Common Scale.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean of year.	Annual Means smoothed.
1847.........	...	...	...	...	...	6·9	6·2	6·9	7·4	10·3	13·1	13·7		
1848.........	14·9	13·1	11·7	9·7	9·1	6·9	6·3	5·8	8·1	9·3	13·1	13·0	10·1	
1849.........	12·6	11·8	11·2	10·1	8·4	6·9	6·1	5·7	6·1	10·4	12·7	14·0	9·7	
1850.........	12·6	15·4	11·1	9·9	8·7	8·4	6·9	6·9	7·6	10·1	13·5	13·0	10·3	10·03
1851.........	13·4	12·9	11·4	10·8	9·0	7·7	5·7	6·4	8·0	9·6	11·0	13·7	9·9	10·14
1852.........	13·6	12·5	11·9	11·8	10·5	8·3	6·7	6·4	7·1	9·9	13·6	11·5	10·3	10·32
1853.........	14·1	13·4	13·1	11·3	10·6	7·6	5·8	7·6	7·4	11·7	12·8	14·4	10·8	10·45
1854.........	13·8	14·2	12·9	11·1	10·3	8·2	5·8	7·1	7·4	10·3	11·7	10·8	10·3	10·36
1855.........	12·3	11·3	11·4	10·9	10·3	8·0	6·8	8·0	8·2	10·0	12·4	12·6	10·2	10·11
1856.........	12·3	12·1	10·5	10·9	10·0	7·9	5·9	7·0	7·5	9·3	11·9	12·1	9·7	9·92
1857.........	11·3	13·2	12·6	10·9	9·6	8·7	6·6	4·8	6·5	10·0	11·8	13·3	9·9	9·87
1858.........	13·4	12·7	10·5	10·8	9·5	8·4	6·8	6·4	7·4	10·2	12·1	11·7	10·0	9·85
1859.........	12·3	11·5	12·1	10·6	9·2	8·0	7·1	6·1	7·4	9·1	11·3	12·5	9·7	9·75
1860.........	13·2	10·8	10·7	9·0	8·6	8·1	5·3	6·6	6·9	8·9	13·8	13·6	9·6	9·66
1861.........	12·8	13·7	11·2	10·1	9·6	7·9	5·0	4·8	7·2	8·4	12·1	12·6	9·6	9·69
1862.........	12·1	13·1	11·9	10·3	9·4	7·4	6·6	6·9	7·0	9·1	11·4	13·6	9·9	9·80
1863.........	13·0	14·7	10·5	10·3	9·5	6·6	6·3	6·0	7·5	9·8	12·5	12·4	9·9	9·89
1864..	13·5	12·5	11·6	9·7	9·3	7·9	5·7	6·3	8·2	10·8	11·3	13·1	10·0	9·91
1865.........	13·0	11·9	11·3	10·1	9·1	8·5	6·3	5·6	8·2	9·9	12·1	11·2	9·7	9·97
1866.........	13·7	14·0	11·0	11·1	9·4	7·1	6·0	5·7	8·1	10·8	14·3	13·6	10·4	10·08
1867.........	13·3	14·0	11·8	9·7	8·9	7·4	6·1	5·7	6·9	10·2	12·6	13·5	10·0	10·13
1868...... ..	13·3	13·1	11·2	10·1	9·3	7·4	6·5	6·0	7·9	11·1	13·9	13·7	10·3	10·03
1869.........	13·3	12·7	10·8	10·2	9·4	7·4	6·4	6·2	6·7	9·7	12·3	10·8	9·7	9·85
1870.........	12·8	13·2	11·1	10·7	8·9	7·7	5·4	6·4	7·1	9·1	11·0	12·2	9·6	9·77
1871.........	13·1	12·7	11·9	10·4	8·8	7·7	6·6	6·0	7·0	10·6	11·3	12·1	9·9	9·83
1872.........	13·8	14·5	11·3	10·6	9·2	7·4	5·4	6·3	7·2	10·6	13·7	11·3	10·1	9·86
1873.........	13·6	11·4	10·3	9·4	8·6	6·5	4·8	5·8	7·0	11·2	12·3	13·8	9·6	9·77
1874.........	13·5	13·3	11·2	10·0	8·4	7·1	5·4	6·3	6·5	10·4	12·1	12·5	9·7	9·72
1875.........	13·4	11·6	11·0	10·0	8·9	7·2	6·7	6·4	6·1	10·1	12·4	12·6	9·7	9·80
1876.........	13·0	13·1	10·6	9·8	9·0	7·5	5·9	6·5	8·0	11·3	12·3	13·8	10·1	9·94
1877.........	12·3	12·0	11·5	10·6	9·3	8·1	7·4	7·2	8·4	8·8	12·3	10·9	9·9	10·08
1878.........	12·8	13·5	11·3	10·7	9·4	8·4	6·8	6·5	7·7	10·4	10·6	14·1	10·2	10·24
1879.........	14·1	12·6	12·6	10·6	9·0	7·2	7·0	6·0	7·8	10·4	13·8	15·3	10·5	
1880.........	14·6	13·6	11·2	10·4	9·3	8·2	6·7	7·2	7·3	10·1	12·9	13·9	10·4	
Means of columns.	13·18	12·91	11·41	10·38	9·29	7·66	6·21	6·34	7·38	10·06	12·42	12·85	10·0	

4. The annual means in the last column are obtained from those in the next preceding column in the following manner, the object being to remove the irregularities in the progression of the latter numbers and to substitute for those numbers a smooth-flowing series that will retain all the principal characteristics of any variation of long-period that affects them: first, the means are taken of every two adjacent numbers forming a new series the number of which is one less than the number of years; second, the new series of numbers is treated in the same manner, giving a second new series: and the process is repeated a third and a fourth time, the last-resulting series of numbers being those entered in the last column of Table Ia. The annual means and the smoothed annual means are curved in fig. 1, and the latter curve shows distinct maxima in 1853 and 1867, and minima in 1860 or 1861 and between 1870 and 1874, times that imply a rough general correspondence of ebb and flow with that of an inverted sun-spot curve for the same period.

5. The numbers at the foot of Table Ia we adopt as representing

Table II.—Exhibiting the Proportional Temperature-range, the Normal for each Month being reckoned = 100.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual Means.
1847 ..	...	...	...	...	...	90	100	110	100	102	106	107	
1848...	113	102	103	93	98	90	102	92	109	92	106	102	100·2
1849...	95	91	98	97	90	90	98	90	82	103	102	109	95·4
1850...	95	119	97	95	94	109	111	110	103	100	109	102	103·7
1851...	102	100	100	104	97	100	92	102	108	95	89	107	99·7
1852...	103	97	104	113	113	108	108	102	96	98	110	90	103·5
1853...	107	104	115	109	114	99	94	121	100	116	103	112	107·8
1854...	105	110	113	107	111	106	94	113	100	102	94	84	103·2
1855...	93	88	100	105	111	104	110	127	111	99	100	98	103·8
1856...	93	94	92	105	108	103	95	111	101	92	96	95	98·7
1857...	86	102	110	105	103	113	106	76	88	99	95	104	98·9
1858...	102	98	92	104	102	109	110	102	100	101	98	91	100·7
1859...	93	89	106	102	99	104	115	97	100	90	91	98	98·7
1860...	100	84	94	87	92	105	85	105	93	88	111	106	95·8
1861...	97	106	98	97	103	103	81	76	97	83	98	98	94·7
1862...	92	102	104	99	101	96	106	110	95	90	92	106	99·4
1863...	98	114	92	99	102	86	102	95	101	97	101	97	98·7
1864...	102	97	102	93	100	103	92	100	111	107	91	102	100·0
1865...	98	92	99	97	98	108	102	89	111	98	98	87	98·1
1866...	104	109	96	107	101	92	97	90	109	107	115	106	102·7
1867...	101	109	104	93	96	96	98	90	93	101	102	105	99·0
1868...	101	102	98	97	100	96	105	95	107	110	112	107	102·5
1869...	101	98	95	98	101	96	103	98	91	96	99	84	96·7
1870...	97	102	97	103	96	100	87	102	96	90	89	95	96·2
1871...	99	98	104	100	95	100	106	95	95	105	91	95	98·6
1872...	104	112	99	102	99	96	87	100	97	105	110	88	99·9
1873...	103	88	90	90	92	84	77	92	95	111	99	108	94·1
1874...	102	103	98	96	90	92	87	100	88	103	98	98	96·2
1875...	102	89	96	96	96	94	108	102	82	100	100	98	96·9
1876...	98	102	93	94	97	97	95	103	108	112	99	108	100·5
1877...	93	93	101	102	100	105	119	114	114	87	99	85	101·0
1878...	97	105	99	103	101	110	110	103	104	103	85	110	102·5
1879...	107	98	111	102	97	94	113	95	105	103	111	120	104·7
1880...	111	105	98	100	100	106	108	114	99	100	104	109	104·5

the annual variation, combined with the annual mean value of temperature-range, on the scale of the period 1873 to 1880.

6. Arranging now the results in the manner adopted by Dr. Stewart in following out his hypothesis that solar activity varies with the temperature-range, being inversely proportional to the mean range in different months of the typical year and directly proportional to the range in the same month of different years, we convert the several monthly numbers of Table Ia into corresponding percentages of solar activity, by multiplying them by 100 and dividing by the mean temperature-range of all the years for the corresponding month. Table II has been formed in this manner.

The numbers in the last column vary, of course, in the same manner as, though not exactly proportionally to, the annual means of Table Ia.

C. *Lunar Annual Variation.*

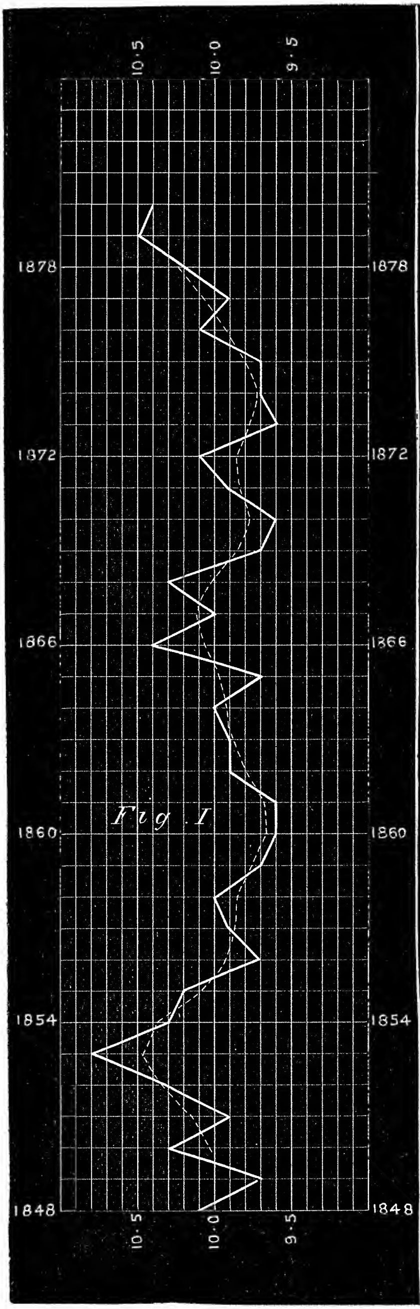
7. The purpose of this section and the process by which it is served may be described in Dr. Stewart's own words, which are as follows:—

"It will be of interest to determine whether the temperature-range has any reference to the relative position of the sun and moon. For this purpose the whole period of observation has been portioned out into lunations, beginning with new moon. Each lunation is divided into eight parts, entitled—(0), (1), (2), (3), (4), (5), (6), (7),—(0) denoting new, and (4) full moon.

"The various lunations with the corresponding values of the temperature-range are exhibited in Table III. It will, however, be here necessary to state how these values have been obtained. Take the dates (civil time) of the four quarterly phases of the moon as given by the "Nautical Almanac," and under each of these dates, as a centre, group seven observations. Each value in Table III corresponding to (0), (2), (4), (6) is thus the mean of seven separate observations of daily range.

"The half-quarterly phases (1), (3), (5), (7) are then interpolated in point of time, so that sometimes their date will fall upon a given civil day, and sometimes between one civil day and another. In the former case the mean of seven observations, and in the latter the mean of six, is taken."

The only special point that needs mention is, that only the observations of the 33 full years 1847 ·75 to 1880 ·75, including 33 complete winters and 33 complete summers, are made use of in the calculations of lunar variations, those of the portions of a summer or winter, 1847 ·42 to 1847 ·75 and 1880 ·75 to 1881 ·0, being omitted.


10·5
10·0
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1878
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Fig I.

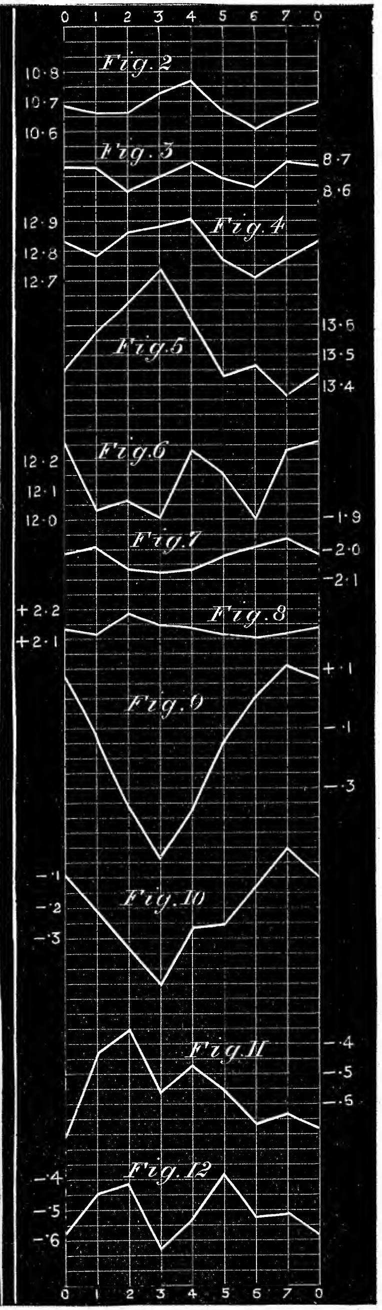
0 1 2 3 4 5 6 7 0
Fig. 2
10·8
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Fig. 3
8·7
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Fig. 4
12·9
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Fig. 5
13·6
13·5
13·4
Fig. 6
12·2
12·1
12·0
Fig. 7
−1·9
−2·0
−2·1
Fig. 8
+2·2
+2·1
Fig. 9
+·1
−·1
−·3
Fig. 10
−·1
−·2
−·3
Fig. 11
−·4
−·5
−·6
Fig. 12
−·4
−·5
−·6
0 1 2 3 4 5 6 7 0

Table III.—Exhibiting the Temperature-Ranges grouped according to Lunations.

No. of lunation.	Date of new moon beginning lunation.	(0).	(1).	(2).	(3).	(4).	(5).	(6).	(7).
1	Sept. 9, 1847	7·0°	8·2°	8·8°	10·3	10·1°	9·7°	9·1°	10·6°
2	Oct. 8 „	12·6	14·1	11·2	11·4	11·9	13·7	13·0	9·0
3	Nov. 7 „	12·5	16·6	19·1	19·1	17·7	14·5	15·5	17·9
4	Dec. 7 „	17·0	15·5	17·7	16·1	11·2	15·0	18·1	17·5
5	Jan. 6, 1848	17·3	18·6	19·8	20·2	18·2	16·6	14·9	15·3
6	Feb. 4 „	16·7	17·1	15·3	15·2	16·7	15·9	13·1	12·9
7	Mar. 5 „	14·6	15·7	15·8	13·2	14·3	12·6	12·6	12·0
(8)	April 3 „	13·3	12·6	10·2	10·4	12·4	11·4	11·0	10·2
(9)	May 2 „	10·3	10·0	9·8	10·4	10·1	9·9	11·6	11·8
(10)	June 1 „	9·2	8·3	9·0	9·6	7·6	5·7	7·2	8·3
(11)	June 30 „	9·0	8·7	8·7	8·7	7·5	5·5	6·0	7·2
(12)	July 29 „	6·9	6·2	6·5	6·5	7·1	6·8	6·4	8·0
(13)	Aug. 28 „	7·3	7·6	8·6	9·2	10·3	10·4	10·6	9·6
14	Sept. 26 „	8·6	10·6	10·1	8·3	9·3	9·1	9·5	12·1
15	Oct. 26 „	14·6	14·8	14·0	14·7	16·0	15·8	14·6	12·4
16	Nov. 25 „	15·9	18·6	16·7	14·7	15·5	14·7	13·6	16·0
17	Dec. 25 „	17·0	14·1	15·2	15·9	16·5	16·0	14·1	16·7
18	Jan. 23, 1849	13·9	12·5	12·2	15·2	16·7	13·1	11·7	11·9
19	Feb. 22 „	12·6	14·2	15·7	14·4	12·9	10·9	12·9	13·3
(20)	Mar. 24 „	12·9	13·7	14·6	13·3	13·3	13·7	11·5	10·8
(21)	April 22 „	11·1	10·5	9·2	9·1	10·9	10·0	9·8	10·1
(22)	May 21 „	10·2	10·3	9·1	10·1	9·2	8·5	8·5	7·5
(23)	June 20 „	6·6	6·9	7·6	7·4	6·0	7·2	7·5	9·0
(24)	July 19 „	9·4	8·3	6·1	4·5	5·2	5·9	6·4	6·6
(25)	Aug. 17 „	6·9	7·5	7·0	7·9	7·9	8·3	6·7	5·8
26	Sept. 16 „	5·2	6·2	9·2	9·5	11·8	12·8	9·9	9·1
27	Oct. 15 „	10·0	11·3	15·1	17·4	14·9	12·3	13·2	13·0
28	Nov. 14 „	14·1	15·6	15·8	18·8	17·5	17·2	17·6	17·3
29	Dec. 14 „	17·2	15·2	16·1	16·9	15·6	13·6	13·9	14·3
30	Jan. 13, 1850	14·2	13·7	15·7	17·7	15·9	13·9	18·9	20·3
31	Feb. 11 „	18·8	14·4	16·3	19·4	18·3	19·6	16·2	13·9
(32)	Mar. 13 „	11·3	10·3	11·8	12·8	12·5	9·5	10·2	12·3
(33)	April 12 „	11·3	11·6	11·5	12·6	13·1	11·8	12·0	11·4
(34)	May 11 „	9·6	9·4	10·2	10·3	10·0	9·6	9·4	9·9
(35)	June 9 „	10·6	9·7	9·4	9·5	9·5	10·8	10·4	9·4
(36)	July 9 „	9·3	8·5	7·2	7·6	5·6	7·0	8·4	7·4
(37)	Aug. 7 „	7·1	7·4	8·6	7·9	8·2	9·2	8·9	8·8
(38)	Sept. 5 „	8·4	8·2	8·7	9·1	6·2	9·4	9·7	9·9
39	Oct. 5 „	11·3	11·6	12·4	13·5	15·0	13·7	9·5	10·0
40	Nov. 3 „	12·6	13·5	15·7	17·0	17·6	15·9	17·0	16·8
41	Dec. 3 „	15·0	14·8	14·8	15·9	15·0	14·4	16·3	16·5
42	Jan. 1, 1851	15·9	13·9	13·5	16·2	15·7	13·1	19·2	15·5
43	Jan. 31 „	16·2	13·7	12·8	12·7	14·0	17·8	18·8	16·0
44	Mar. 2 „	12·8	13·0	13·6	14·3	13·3	13·3	12·8	13·3
(45)	April 1 „	14·4	12·5	12·4	12·3	13·3	13·7	11·5	12·1
(46)	April 30 „	12·3	10·2	10·3	11·3	10·9	9·9	10·2	11·4
(47)	May 30 „	10·5	9·7	9·1	7·1	8·5	9·6	10·3	9·5
(48)	June 28 „	8·0	8·8	8·9	7·9	6·1	5·1	6·4	6·7
(49)	July 28 „	5·2	6·2	6·8	7·1	8·7	8·1	7·5	6·7
(50)	Aug. 26 „	6·2	7·3	8·1	8·7	9·1	9·5	10·6	11·0
51	Sept. 24 „	11·2	9·1	8·1	10·3	10·5	10·5	10·4	11·3
52	Oct. 24 „	12·7	13·8	14·8	14·9	12·1	10·9	12·4	12·0
53	Nov. 22 „	12·4	14·0	13·7	14·1	16·5	17·0	17·6	17·3

No. of lunation.	Date of new moon beginning lunation.	(0).	(1).	(2).	(3).	(4).	(5).	(6).	(7).
54	Dec. 22, 1851	16·9°	15·1°	16·0°	18·3°	14·6°	14·2°	15·7°	15·5°
55	Jan. 21, 1852	16·9	18·6	14·0	14·2	15·7	16·3	15·5	14·3
56	Feb. 20 ,,	15·6	13·9	12·6	12·6	15·7	19·1	15·5	13·0
(57)	Mar. 21 ,,	12·6	12·5	12·9	13·0	14·4	14·0	12·7	12·8
(58)	April 19 ,,	12·6	13·0	13·0	12·8	13·4	12·7	11·1	11·5
(59)	May 19 ,,	11·5	11·4	11·3	11·8	13·9	12·1	10·9	10·5
(60)	June 17 ,,	8·5	6·1	6·3	6·7	7·1	6·7	7·5	7·5
(61)	July 17 ,,	7·7	8·9	8·4	5·8	6·2	6·3	4·3	4·5
(62)	Aug. 15 ,,	6·2	7·9	8·8	9·4	9·5	9·2	8·8	8·6
63	Sept. 14 ,,	7·1	6·5	7·2	8·4	8·1	9·4	11·1	10·6
64	Oct. 13 ,,	9·1	9·4	11·1	12·7	13·9	14·2	14·7	14·8
65	Nov. 11 ,,	15·3	16·0	15·1	14·2	16·4	15·5	11·0	6·7
66	Dec. 11 ,,	11·0	14·7	15·7	16·0	13·9	13·0	15·6	16·0
67	Jan. 9, 1853	15·1	15·2	16·0	16·4	16·5	16·2	16·3	15·5
68	Feb. 8 ,,	15·9	16·0	14·7	13·4	13·8	13·9	15·8	15·7
(69)	Mar. 10 ,,	14·8	14·7	14·7	14·1	15·1	13·1	12·3	12·3
(70)	April 8 ,,	12·9	12·6	12·6	12·8	13·0	12·3	12·0	12·3
(71)	May 8 ,,	12·5	12·2	11·5	11·3	11·7	11·9	11·2	10·5
(72)	June 7 ,,	11·9	11·1	7·3	6·5	5·4	6·3	8·1	7·7
(73)	July 6 ,,	6·9	5·7	6·8	6·6	5·5	6·1	6·7	7·5
(74)	Aug. 5 ,,	8·0	9·4	9·8	9·2	9·2	8·8	8·9	5·5
(75)	Sept. 3 ,,	4·6	6·9	7·7	9·3	9·9	10·4	9·2	9·0
76	Oct. 3 ,,	10·7	10·2	11·3	12·6	14·1	15·6	14·8	13·6
77	Nov. 1 ,,	15·0	14·7	14·5	15·5	13·3	12·7	14·2	15·5
78	Dec. 1 ,,	15·3	16·0	16·8	16·3	14·1	14·8	16·4	18·4
79	Dec. 30 ,,	17·7	16·3	15·2	14·9	15·2	16·8	16·4	14·9
80	Jan. 28, 1854	14·6	15·8	18·4	17·2	14·2	16·0	15·5	14·2
81	Feb. 27 ,,	14·3	14·0	16·0	16·5	14·3	14·7	14·5	14·1
(82)	Mar. 28 ,,	13·5	13·1	12·3	12·2	12·5	13·0	13·0	12·6
(83)	April 27 ,,	11·7	11·5	11·7	11·8	11·7	11·7	11·1	10·6
(84)	May 27 ,,	11·4	10·7	11·5	10·6	8·3	9·2	9·7	8·5
(85)	June 25 ,,	8·0	7·3	6·5	7·0	9·1	8·0	5·9	5·7
(86)	July 25 ,,	5·9	6·0	5·3	5·8	6·9	8·2	8·4	8·9
(87)	Aug. 23 ,,	9·2	8·3	7·3	7·3	6·5	4·8	6·5	9·5
88	Sept. 22 ,,	9·6	10·6	11·3	11·1	9·4	9·0	9·9	12·3
89	Oct. 22 ,,	14·2	14·4	12·0	9·8	11·6	14·9	13·9	12·4
90	Nov. 20 ,,	14·4	15·6	12·9	9·8	11·0	13·1	12·6	12·0
91	Dec. 20 ,,	11·5	11·6	12·4	12·8	12·6	12·1	12·6	13·7
92	Jan. 18, 1855	16·8	15·6	14·1	15·0	14·2	12·4	12·3	12·4
93	Feb. 17 ,,	11·7	11·3	12·4	12·5	11·7	12·1	13·2	13·4
(94)	Mar. 18 ,,	13·0	14·4	13·6	11·9	11·8	12·5	12·8	12·7
(95)	April 16 ,,	12·0	12·3	11·9	11·6	11·8	11·6	11·9	11·9
(96)	May 16 ,,	10·8	10·3	11·6	12·0	11·8	10·5	9·2	9·8
(97)	June 14 ,,	9·9	8·7	8·3	8·5	6·1	6·0	7·5	6·4
(98)	July 14 ,,	6·8	8·0	8·6	9·0	9·1	8·7	7·9	8·6
(99)	Aug. 13 ,,	10·1	9·3	9·3	9·5	9·8	9·0	8·5	7·6
100	Sept. 11 ,,	8·2	9·5	9·6	9·9	10·2	10·5	10·3	11·8
101	Oct. 11 ,,	12·9	10·6	10·2	10·5	10·2	11·8	14·8	15·0
102	Nov. 10 ,,	12·5	12·5	13·2	14·1	13·5	13·6	14·4	12·9
103	Dec. 9 ,,	10·7	11·6	13·9	16·0	16·4	15·7	17·2	15·7
104	Jan. 8, 1856	14·0	14·3	14·4	14·2	12·8	11·0	13·4	15·3
105	Feb. 6 ,,	13·7	12·6	12·5	14·5	14·3	12·1	12·6	11·1
(106)	Mar. 7 ,,	11·5	11·9	11·5	12·0	11·9	12·4	12·4	11·9
(107)	April 5 ,,	12·1	12·9	12·5	12·7	12·8	12·0	11·3	10·6
(108)	May 4 ,,	11·0	11·5	10·9	10·8	11·6	12·5	10·5	11·2
(109)	June 3 ,,	9·8	8·1	8·5	8·6	8·6	9·2	8·7	8·3
(110)	July 2 ,,	6·2	6·7	7·8	7·5	7·6	6·3	5·5	6·3

No. of lunation.	Date of new moon beginning lunation.	(0).	(1).	(2).	(3).	(4).	(5).	(6).	(7).
(111)	Aug. 1, 1856	6·8°	6·5°	7·8°	8·3°	8·8°	8·5°	8·1°	8·2°
(112)	Aug. 31 ,,	7·5	7·5	9·0	9·8	8·9	6·4	6·6	9·2
113	Sept. 29 ,,	9·5	9·3	10·6	10·4	10·9	10·7	10·2	10·2
114	Oct. 29 ,,	11·3	10·8	10·8	12·8	15·7	15·8	14·4	12·5
115	Nov. 27 ,,	12·8	13·9	13·8	16·1	14·3	12·6	13·3	13·7
116	Dec. 27 ,,	13·2	10·2	9·0	10·7	12·1	12·6	14·1	14·0
117	Jan. 26, 1857	13·6	15·0	13·6	11·9	14·9	15·0	15·9	15 6
118	Feb. 24 ,,	15·0	16·0	14·4	13·8	13·9	12·5	15·7	14·3
(119)	Mar. 26 ,,	13·7	13·2	13·1	12·9	12·8	11·5	10·4	12·4
(120)	April 24 ,,	13·5	12·2	10·5	9·9	10·8	11·0	11·0	10·5
(121)	May 23 ,,	10·6	12·4	12·2	11·2	10·5	11·0	10·6	9·9
(122)	June 22 ,,	8·8	6·9	7·4	8·4	7·7	7·8	8·1	7·9
(123)	July 21 ,,	7·6	6·5	4·7	4·6	4·1	3·6	5·3	6·3
(124)	Aug. 19 ,,	5·1	6·0	6·8	7·4	7·7	6·1	6·6	7·3
125	Sept. 18 ,,	5·4	7·0	9·0	9·4	9·1	9·5	11·2	11·5
126	Oct. 18 ,,	10·9	11·4	13·0	12·4	12·4	11·3	11·3	12·9
127	Nov. 16 ,,	14·2	15·0	14·6	13·0	13·9	15·0	14·1	13·6
128	Dec. 16 ,,	13·6	15·5	15·5	16·5	17·1	15·8	14·7	16·2
129	Jan. 15, 1858	16·1	15·5	13·9	12·0	14·6	13·5	13·6	15·0
130	Feb. 14 ,,	15·9	15·6	13·6	13·7	11·5	10·6	10·5	11·2
(131)	Mar. 15 ,,	11·8	12·3	12·4	11·9	12·9	12·8	12·3	11·8
(132)	April 14 ,,	12·2	12·0	12·0	12·3	12·1	11·5	10·2	10·1
(133)	May 13 ,,	10·9	10·6	10·2	10·9	11·2	10·2	10·4	10·9
(134)	June 11 ,,	10·3	10·4	9·9	8·0	7·2	8·0	8·5	8·2
(135)	July 11 ,,	6·8	6·1	7·3	8·2	7·1	6·6	6·7	6·5
(136)	Aug. 9 ,,	7·2	8·0	8·2	8·0	7·2	6·9	8·8	9·8
(137)	Sept. 7 ,,	9·4	7·4	7·1	8·1	8·3	8·4	9·0	10·0
138	Oct. 7 ,,	11·0	10·4	9·2	10·7	12·4	13·6	14·0	14·2
139	Nov. 5 ,,	14·0	13·7	15·1	14·9	13·5	11·6	10·9	12·6
140	Dec. 5 ,,	11·6	12·1	14·2	12·4	14·0	14·6	13·7	11·2
141	Jan. 4, 1859	13·7	15·9	14·2	14·1	15·7	14·9	11·2	12·1
142	Feb. 3 ,,	13·7	12·1	14·9	17·0	15·7	10·4	10·9	10·4
143	Mar. 5 ,,	10·8	11·1	12·2	13·9	14·8	14·5	12·0	12·5
(144)	April 3 ,,	13·0	12·7	12·1	12·0	11·9	11·2	11·4	11·6
(145)	May 3 ,,	11·3	11·3	9·9	8·6	9·9	11·1	10·1	9·9
(146)	June 1 ,,	11·3	10·2	8·6	9·0	8·4	8·5	8·2	8·2
(147)	June 30 ,,	9·2	9·7	9·7	10·4	9·3	5·9	5·3	5·8
(148)	July 30 ,,	5·0	5·8	7·0	8·6	8·3	8·7	6·7	3·8
(149)	Aug. 28 ,,	5·0	7·4	7·2	7·1	7·6	8·2	8·2	9·2
150	Sept. 26 ,,	10·1	10·2	9·3	8·6	9·5	9·6	9·9	10·3
151	Oct. 26 ,,	11·7	13·3	12·9	12·6	12·8	11·5	11·8	13·7
152	Nov. 24 ,,	13·3	12·7	13·3	15·9	13·9	13·3	14·1	14·0
153	Dec. 24 ,,	14·0	15·3	15·7	15·0	15·3	16·2	14·5	13·2
154	Jan. 23, 1860	13·9	15·7	14·1	13·1	12·3	13·8	13·1	11·4
155	Feb. 22 ,,	9·9	10·8	12·4	13·4	12·7	11·1	10·3	10·8
(156)	Mar. 22 ,,	12·3	12·5	12·6	12·0	11·5	11·5	10·5	9·9
(157)	April 21 ,,	10·0	9·0	8·2	10·4	11·0	10·2	9·8	9·4
(158)	May 21 ,,	7·6	8·1	9·5	10·3	10·0	9·9	9·7	7·4
(159)	June 19 ,,	9·1	10·1	9·4	7·7	5·7	5·5	6·3	6·5
(160)	July 18 ,,	5·6	5·8	6·3	5·7	5·4	6·6	7·6	7·1
(161)	Aug. 17 ,,	6·9	7·4	8·4	8·1	8·4	6·7	5·4	6·1
162	Sept. 15 ,,	7·5	9·1	9·6	8·7	8·0	8·6	9·4	9·6
163	Oct. 14 ,,	11·5	11·5	10·8	10·3	10·9	14·0	15·8	15·7
164	Nov. 13 ,,	15·6	16·3	14·8	14·3	16·5	17·3	16·2	16·4
165	Dec. 12 ,,	12·7	11·7	14·4	16·4	15·6	14·2	14·0	12·1
166	Jan. 11, 1861	13·6	12·4	13·0	17·9	16·4	14·6	14·7	12·4
167	Feb. 10 ,,	12·4	13·1	19·1	17·8	15·9	14·8	12·1	14·1

No. of lunation.	Date of new moon beginning lunation.	(0).	(1).	(2).	(3).	(4).	(5).	(6).	(7).
(168)	Mar. 11, 1861	15·9°	13·9°	12·1°	12·1°	12·0°	12·2°	12·0°	12·1°
(169)	April 10 ,,	12·1	11·6	11·2	10·8	10·3	10·8	11·5	12·4
(170)	May 10 ,,	11·0	9·6	9·8	10·6	10·7	11·1	11·4	9·7
(171)	June 8 ,,	9·6	10·0	9·5	7·4	7·6	7·8	6·0	4·6
(172)	July 8 ,,	6·5	7·3	6·2	5·5	5·3	5·5	5·9	6·9
(173)	Aug. 6 ,,	7·4	6·8	5·1	3·5	4·7	5·5	5·6	5·6
(174)	Sept. 5 ,,	6·0	7·2	9·2	9·1	8·6	8·4	8·4	7·6
175	Oct. 4 ,,	8·1	9·8	9·4	8·3	8·5	9·9	10·7	12·5
176	Nov. 2 ,,	14·1	14·7	13·3	11·3	11·7	14·4	14·7	14·2
177	Dec. 2 ,,	15·1	14·8	14·0	13·2	13·1	14·4	13·6	14·3
178	Dec. 31 ,,	15·3	14·6	11·6	13·0	14·4	14·1	13·2	15·3
179	Jan. 30, 1862	14·0	16·6	18·8	15·0	12·0	13·9	15·1	13·9
180	Feb. 28 ,,	12·5	12·9	12·4	14·6	14·3	13·9	12·8	12·4
(181)	Mar. 30 ,,	12·3	11·4	10·8	11·5	11·2	11·0	11·9	11·9
(182)	April 29 ,,	11·6	11·3	10·4	10·0	10·8	11·2	10·3	9·5
(183)	May 28 ,,	10·0	9·5	9·7	9·7	6·7	6·4	8·6	8·8
(184)	June 27 ,,	8·5	6·7	7·8	8·3	7·7	7·5	7·9	7·7
(185)	July 27 ,,	6·4	6·3	7·6	7·9	7·9	6·9	6·5	8·1
(186)	Aug. 25 ,,	8·1	8·2	8·1	7·7	8·4	8·1	8·1	7·4
187	Sept. 24 ,,	8·2	7·2	6·8	8·1	9·0	9·1	9·4	11·6
188	Oct. 23 ,,	12·3	11·7	12·4	12·8	13·5	13·2	14·6	14·8
189	Nov. 21 ,,	12·0	9·6	11·5	12·2	13·6	15·2	15·2	15·5
190	Dec. 21 ,,	17·0	17·9	15·9	15·3	15·6	16·0	14·9	13·8
191	Jan. 19, 1863	13·1	14·1	15·1	13·3	14·1	14·4	14·9	15·2
192	Feb. 18 ,,	16·3	19·4	20·4	15·3	11·5	10·5	11·9	13·5
(193)	Mar. 19 ,,	13·5	12·0	11·2	11·0	11·4	12·9	12·7	11·5
(194)	April 18 ,,	11·6	11·7	10·5	10·4	10·7	10·7	11·0	10·4
(195)	May 17 ,,	10·5	11·3	10·4	10·4	10·2	9·5	8·0	7·0
(196)	June 16 ,,	6·7	5·8	6·4	7·1	8·1	8·0	6·5	7·3
(197)	July 16 ,,	8·2	7·8	6·3	5·8	5·9	6·1	7·1	6·0
(198)	Aug. 14 ,,	5·5	7·0	7·2	7·1	7·5	7·8	7·1	7·4
199	Sept. 13 ,,	9·0	9·8	9·3	8·5	8·4	9·7	10·0	10·0
200	Oct. 13 ,,	11·1	11·6	11·8	11·1	10·2	12·5	13·3	13·1
201	Nov. 11 ,,	14·0	13·7	14·5	14·2	15·0	15·3	16·6	12·0
202	Dec. 11 ,,	11·3	13·3	14·0	14·9	15·0	13·6	13·4	14·4
203	Jan. 9, 1864	16·1	14·3	14·9	14·5	15·1	16·0	15·1	15·7
204	Feb. 7 ,,	17·7	16·5	12·8	11·2	12·7	13·4	13·7	14·8
(205)	Mar. 8 ,,	13·4	12·3	12·7	12·7	12·2	12·3	11·2	11·4
(206)	April 6 ,,	11·9	10·2	10·7	11·8	11·9	10·5	9·1	10·0
(207)	May 6 ,,	10·0	9·6	9·9	10·7	10·1	11·0	11·3	11·0
(208)	June 4 ,,	10·2	11·0	10·9	10·4	7·8	6·0	5·9	6·8
(209)	July 4 ,,	8·2	7·3	6·6	5·3	4·1	4·7	6·7	7·8
(210)	Aug. 2 ,,	6·8	6·6	6·6	6·2	7·5	8·6	7·2	6·7
(211)	Sept. 1 ,,	6·5	7·4	8·6	8·8	9·1	9·6	9·5	11·7
212	Oct. 1 ,,	12·1	11·4	11·8	11·4	12·2	14·3	11·9	12·7
213	Oct. 30 ,,	13·8	11·6	11·0	11·9	14·8	16·1	13·1	13·1
214	Nov. 29 ,,	11·5	11·4	13·8	15·2	16·7	15·8	14·8	15·1
215	Dec. 29 ,,	14·0	14·4	14·3	15·0	16·2	16·4	15·2	14·2
216	Jan. 27, 1865	13·6	11·2	12·1	12·1	12·4	15·4	13·5	13·4
217	Feb. 26 ,,	13·1	12·1	11·2	11·9	14·4	14·5	13·0	12·0
(218)	Mar. 27 ,,	12·1	12·5	12·6	12·3	11·4	11·4	11·6	10·7
(219)	April 25 ,,	9·7	9·8	10·3	11·3	10·8	8·6	8·4	10·2
(220)	May 25 ,,	10·8	10·6	9·5	11·3	10·5	8·4	8·4	9·9
(221)	June 23 ,,	9·4	9·1	8·2	5·1	5·2	7·2	7·7	7·5
(222)	July 22 ,,	7·8	7·9	8·1	8·4	8·3	7·9	5·2	4·2
(223)	Aug. 21 ,,	4·1	5·6	7·0	7·3	8·3	8·5	7·1	8·7
224	Sept. 20 ,,	10·9	10·5	10·3	10·3	10·5	10·9	10·9	11·4

No. of lunation.	Date of new moon beginning lunation.	(0).	(1).	(2).	(3).	(4).	(5).	(6).	(7).
225	Oct. 19, 1865	12·7°	12·2°	10·6°	10·2°	10·3°	11·9°	13·5°	15·4°
226	Nov. 18 „	15·6	14·3	14·6	12·3	10·3	10·1	11·3	14·5
227	Dec. 18 „	13·8	13·2	14·3	15·1	13·4	13·0	10·4	12·4
228	Jan. 17, 1866	14·1	14·5	13·7	12·3	15·3	13·9	11·8	15·3
229	Feb. 15 „	13·8	12·5	14·6	12·9	12·1	10·2	10·8	11·1
(230)	Mar. 17 „	10·9	9·5	10·2	12·1	11·4	11·5	11·5	11·6
(231)	April 15 „	11·6	11·6	10·8	9·6	9·2	10·0	9·7	9·7
(232)	May 14 „	9·4	8·7	8·3	8·9	8·9	8·5	8·9	9·0
(233)	June 13 „	7·6	5·0	4·4	5·9	6·4	6·6	6·6	5·8
(234)	July 12 „	6·1	7·1	6·3	5·1	5·4	3·7	4·6	4·7
(235)	Aug. 10 „	3·9	5·2	6·1	6·4	7·1	7·3	6·5	6·6
236	Sept. 9 „	7·4	7·4	8·5	8·1	8·4	9·4	9·0	8·9
237	Oct. 8 „	9·0	9·6	10·5	11·0	12·0	13·5	14·3	13·3
238	Nov. 7 „	12·8	14·0	14·8	14·3	13·2	13·8	14·8	14·9
239	Dec. 7 „	14·3	12·9	11·6	11·6	12·4	14·3	14·8	12·3
240	Jan. 6, 1867	12·4	14·0	13·5	13·4	13·0	12·9	12·9	13·0
241	Feb. 4 „	14·2	14·1	13·0	13·5	13·7	15·2	13·3	12·2
(242)	Mar. 6 „	13·3	13·2	11·5	10·7	9·5	10·4	11·8	10·6
(243)	April 5 „	9·4	9·6	9·9	8·9	9·1	9·8	9·8	8·9
(244)	May 4 „	8·7	8·7	8·8	9·1	9·1	8·6	8·2	8·5
(245)	June 2 „	8·6	8·3	7·8	7·5	8·0	6·2	5·7	6·5
(246)	July 2 „	5·6	5·5	7·7	7·3	4·7	5·5	6·4	5·6
(247)	July 31 „	4·5	5·1	5·1	4·6	4·3	5·4	6·9	7·0
(248)	Aug. 29 „	7·1	6·7	6·3	6·9	6·2	5·6	6·6	7·8
249	Sept. 28 „	8·1	8·4	8·6	10·4	11·0	10·4	9·0	10·1
250	Oct. 27 „	11·5	11·5	13·4	12·7	13·0	13·4	12·7	13·1
251	Nov. 26 „	10·1	9·7	13·5	14·0	12·6	12·0	13·0	12·0
252	Dec. 26 „	13·7	14·9	12·9	13·5	13·1	12·7	13·4	13·1
253	Jan. 25, 1868	12·7	12·6	13·5	11·8	12·0	10·7	11·7	11·7
254	Feb. 23 „	12·5	15·4	12·7	12·6	11·5	10·1	11·3	11·7
(255)	Mar. 24 „	10·8	10·2	10·2	11·6	11·5	9·8	9·9	10·1
(256)	April 23 „	9·8	8·7	8·2	9·4	9·8	9·8	9·3	8·9
(257)	May 22 „	9·4	8·6	7·8	8·5	9·1	6·3	5·6	6·3
(258)	June 20 „	6·2	7·3	8·4	7·8	7·4	8·0	5·8	5·9
(259)	July 20 „	6·1	6·3	5·5	5·7	6·9	5·8	4·2	4·6
(260)	Aug. 18 „	5·3	6·6	7·4	7·1	6·9	7·1	6·5	7·5
261	Sept. 16 „	8·1	7·6	7·7	8·3	8·8	8·5	10·1	13·3
262	Oct. 16 „	13·2	10·6	11·1	10·8	10·4	11·0	13·2	13·2
263	Nov. 14 „	14·2	15·8	15·1	14·0	14·0	14·5	14·8	14·3
264	Dec. 14 „	12·7	12·9	13·1	12·5	12·6	12·4	13·0	13·8
265	Jan. 13, 1869	13·2	13·8	13·9	12·3	11·1	11·0	11·4	12·6
266	Feb. 11 „	15·0	12·1	11·3	12·7	13·0	10·8	10·0	12·1
(267)	Mar. 13 „	11·6	10·7	9·9	9·4	9·7	10·4	10·8	10·2
(268)	April 12 „	9·8	10·4	9·6	8·5	9·7	11·3	10·7	9·3
(269)	May 11 „	9·4	9·7	8·8	8·5	8·4	8·4	8·6	7·5
(270)	June 10 „	7·9	8·8	7·8	6·3	6·2	5·8	6·4	6·8
(271)	July 9 „	7·4	5·9	5·3	4·1	4·9	6·6	7·0	6·8
(272)	Aug. 8 „	6·2	6·6	7·5	6·1	5·0	5·8	5·5	5·4
(273)	Sept. 6 „	6·4	7·4	7·8	6·8	5·8	6·5	5·8	6·0
274	Oct. 5 „	6·2	7·4	9·9	10·7	11·3	11·8	10·5	9·1
275	Nov. 4 „	11·8	12·5	11·0	11·3	12·5	12·4	14·2	10·4
276	Dec. 3 „	9·9	13·2	13·1	8·9	9·0	10·9	9·7	9·9
277	Jan. 2, 1870	10·8	12·7	13·0	12·8	12·4	14·1	12·4	11·9
278	Jan. 31 „	12·3	11·9	9·9	11·5	14·3	14·4	15·5	14·8
279	Mar. 2 „	12·2	11·3	10·7	9·8	10·4	10·7	10·3	10·8
(280)	April 1 „	10·7	11·2	11·0	11·1	10·4	9·4	10·0	10·4
(281)	April 30 „	9·3	7·7	8·8	9·9	8·9	8·8	9·0	8·1

No. of lunation.	Date of new moon beginning lunation.	(0).	(1).	(2).	(3).	(4).	(5).	(6).	(7).
(282)	May 30, 1870	8·8°	8·8°	8·3	8·4°	8·4°	6·2°	6·1°	7·3°
(283)	June 29 ,,	7·1	7·1	6·1	5·7	5·2	4·8	4·5	5·2
(284)	July 28 ,,	4·9	5·4	6·3	7·1	6·0	5·9	6·6	6·5
(285)	Aug. 27 ,,	5·9	6·0	5·9	7·7	8·0	7·6	6·0	5·0
286	Sept. 25 ,,	6·5	8·2	8·8	7·4	7·6	10·1	9·3	9·9
287	Oct. 24 ,,	9·1	8·1	9·8	9·6	8·5	10·9	12·7	12·9
288	Nov. 23 ,,	10·3	10·2	12·5	12·2	12·3	13·4	12·4	11·8
289	Dec. 22 ,,	12·1	11·0	10·4	12·4	10·9	12·4	11·4	12·4
290	Jan. 21, 1871	13·8	14·8	14·2	12·1	15·9	14·8	12·0	10·3
291	Feb. 19 ,,	12·0	11·8	11·0	10·4	11·6	11·3	13·0	13·8
(292)	Mar. 21 ,,	12·5	11·2	10·5	9·6	9·3	10·8	11·3	10·6
(293)	April 20 ,,	10·6	10·5	9·6	9·3	9·1	8·4	8·1	9·2
(294)	May 19 ,,	8·4	8·2	7·8	8·7	9·8	10·1	8·1	7·3
(295)	June 18 ,,	7·1	6·8	5·6	5·8	6·7	6·7	6·1	6·2
(296)	July 17 ,,	7·1	6·8	6·4	6·1	5·3	4·4	5·2	5·6
(297)	Aug. 16 ,,	5·9	6·3	6·6	6·6	6·1	6·6	6·6	6·1
298	Sept. 15 ,,	7·0	7·7	7·3	6·9	7·7	8·7	8·9	8·4
299	Oct. 14 ,,	9·8	11·2	11·1	11·4	12·5	14·6	14·0	12·4
300	Nov. 12 ,,	9·4	8·4	9·2	10·3	10·7	10·9	11·6	12·1
301	Dec. 12 ,,	12·3	11·3	11·6	11·3	13·0	12·0	12·9	15·0
302	Jan. 10, 1872	15·2	13·7	14·3	13·1	13·1	11·2	11·0	13·2
303	Feb. 9 ,,	15·1	15·2	15·2	13·8	15·2	11·8	11·4	11·8
(304)	Mar. 9 ,,	10·3	9·8	10·6	12·2	12·1	10·2	11·3	11·0
(305)	April 8 ,,	9·9	10·0	10·4	10·7	9·7	9·8	11·2	9·7
(306)	May 7 ,,	8·3	9·3	9·3	9·0	8·5	8·0	8·2	7·9
(307)	June 6 ,,	7·5	9·1	8·8	6·9	6·8	6·2	5·8	5·4
(308)	July 5 ,,	5·7	6·0	5·7	4·8	4·3	5·1	6·1	7·0
(309)	Aug. 4 ,,	6·6	5·5	5·5	6·2	6·3	6·6	6·6	5·9
(310)	Sept. 3 ,,	6·5	7·6	8·5	7·7	5·7	6·7	7·6	7·6
311	Oct. 2 ,,	8·0	7·7	9·3	11·9	10·9	9·9	11·0	13·2
312	Nov. 1 ,,	13·5	13·6	13·3	13·7	14·6	15·3	12·8	11·4
313	Nov. 30 ,,	10·3	8·2	9·5	9·4	10·4	11·9	13·1	13·4
314	Dec. 30 ,,	14·5	13·4	13·1	16·6	17·2	13·0	12·3	12·2
315	Jan. 28, 1873	11·7	12·6	12·4	10·5	11·1	9·8	10·8	12·2
316	Feb. 27 ,,	11·7	10·5	10·5	10·5	10·1	10·7	10·6	10·8
(317)	Mar. 28 ,,	10·7	9·2	10·5	9·0	8·3	9·4	10·1	9·7
(318)	April 27 ,,	8·7	8·5	9·0	8·9	8·0	7·8	8·1	8·8
(319)	May 26 ,,	9·8	8·7	5·6	6·4	6·2	6·1	6·6	6·8
(320)	June 25 ,,	7·9	6·9	5·3	5·2	4·2	4·2	4·3	5·1
(321)	July 24 ,,	5·6	5·0	4·3	5·5	5·4	6·4	6·9	7·4
(322)	Aug. 23 ,,	5·3	4·7	4·7	5·5	5·9	6·8	7·5	7·7
323	Sept. 21 ,,	7·7	7·3	8·0	8·4	10·7	11·8	10·8	10·3
324	Oct. 21 ,,	11·2	11·2	12·9	13·4	11·7	9·7	10·9	12·5
325	Nov. 20 ,,	12·5	13·4	14·6	14·9	15·2	13·2	12·2	14·7
326	Dec. 20 ,,	14·7	13·2	13·6	13·4	13·5	13·4	14·5	15·0
327	Jan. 18, 1874	14·5	12·8	11·8	11·1	12·6	12·8	11·4	14·0
328	Feb. 17 ,,	15·8	12·6	12·4	14·4	12·5	10·6	12·2	12·5
(329)	Mar. 18 ,,	10·8	9·9	10·8	12·1	10·9	10·5	9·1	10·1
(330)	April 16 ,,	10·1	10·2	10·2	9·4	9·6	8·4	7·9	8·4
(331)	May 16 ,,	7·7	8·1	8·8	8·6	9·7	10·3	8·1	7·4
(332)	June 14 ,,	6·9	5·8	4·9	5·4	7·3	7·4	6·9	5·6
(333)	July 13 ,,	5·0	4·0	3·3	4·8	5·3	3·8	5·5	6·5
(334)	Aug. 12 ,,	6·0	5·8	6·1	7·0	8·0	8·2	7·3	6·4
335	Sept. 10 ,,	6·1	6·2	5·7	6·3	7·4	8·4	8·3	8·6
336	Oct. 10 ,,	10·2	10·1	10·8	11·3	11·4	11·4	11·8	10·9
337	Nov. 9 ,,	12·2	14·2	13·2	11·9	12·6	12·1	11·5	12·8
338	Dec. 9 ,,	11·9	12·7	11·2	13·8	15·3	13·2	12·7	14·8

No. of lunation.	Date of new moon beginning lunation.	(0).	(1).	(2).	(3).	(4).	(5).	(6).	(7).
339	Jan. 7, 1875	14·7°	12·3°	11·6°	11·9°	12·7°	13·2°	13·9°	13·3°
340	Feb. 6 ,,	12·3	12·7	11·7	11·3	10·6	10·5	11·8	12·2
(341)	Mar. 8 ,,	12·4	12·2	11·9	10·4	10·3	9·8	8·7	9·6
(342)	April 6 ,,	10·1	10·7	10·4	10·3	10·5	9·5	8·7	8·7
(343)	May 5 ,,	8·6	8·8	9·4	9·6	9·5	8·6	8·0	7·5
(344)	June 4 ,,	8·1	8·9	8·3	7·0	6·4	6·9	6·5	6·2
(345)	July 3 ,,	7·2	7·1	6·7	6·0	6·6	6·3	6·6	6·7
(346)	Aug. 1 ,,	6·5	5·6	4·9	5·8	6·6	7·0	7·3	7·2
(347)	Aug. 31 ,,	6·1	4·5	4·9	7·3	6·2	6·1	6·8	7·1
348	Sept. 29 ,,	8·0	9·4	9·2	11·1	12·7	12·4	10·6	8·1
349	Oct. 29 ,,	8·6	10·6	13·3	12·7	11·7	11·5	12·0	14·3
350	Nov. 28 ,,	13·7	11·9	11·8	12·0	11·8	12·5	13·3	13·1
351	Dec. 28 ,,	13·4	13·6	13·7	13·3	13·4	12·8	11·5	12·3
352	Jan. 26, 1876	13·6	12·0	12·5	14·2	14·1	12·9	12·4	12·9
353	Feb. 25 ,,	12·7	12·1	10·1	9·8	10·7	10·3	10·3	11·3
(354)	Mar. 26 ,,	11·4	10·1	9·5	9·8	9·2	9·3	11·0	10·8
(355)	April 24 ,,	9·9	8·9	8·7	9·4	9·1	8·9	8·9	8·5
(356)	May 23 ,,	8·6	8·3	9·0	8·8	8·6	7·8	5·7	6·4
(357)	June 22 ,,	7·7	7·1	7·3	7·0	6·4	6·4	5·2	5·0
(358)	July 21 ,,	6·3	5·6	5·1	6·8	6·8	6·6	7·1	7·1
(359)	Aug. 19 ,,	6·5	6·4	6·3	5·5	6·8	5·9	8·7	8·2
360	Sept. 18 ,,	7·2	7·8	8·7	9·2	10·4	11·2	10·4	9·9
361	Oct. 17 ,,	10·8	11·8	12·7	13·2	12·8	12·3	11·5	10·9
362	Nov. 16 ,,	11·3	11·6	13·6	14·3	13·0	12·4	12·9	13·4
363	Dec. 15 ,,	13·2	13·6	15·3	15·2	15·4	15·6	16·0	12·4
364	Jan. 14, 1877	9·9	11·0	11·0	11·1	11·9	11·8	9·7	11·9
365	Feb. 13 ,,	13·8	12·4	12·3	12·6	11·5	12·1	12·5	11·3
(366)	Mar. 15 ,,	12·2	12·1	11·2	10·5	10·4	12·3	11·7	10·7
(367)	April 13 ,,	9·8	10·4	10·0	9·5	9·9	10·6	10·1	9·2
(368)	May 13 ,,	8·4	8·7	8·7	9·0	9·4	9·0	8·6	9·6
(369)	June 11 ,,	9·5	10·0	8·0	5·6	6·8	6·9	7·7	7·9
(370)	July 11 ,,	6·7	6·5	6·6	7·2	7·8	7·6	7·1	7·3
(371)	Aug. 9 ,,	7·6	8·6	8·0	7·5	6·9	5·7	6·8	7·5
(372)	Sept. 7 ,,	7·7	8·2	8·6	8·3	8·5	9·2	8·8	6·9
373	Oct. 7 ,,	6·9	8·4	8·2	8·9	9·2	9·9	11·4	12·4
374	Nov. 5 ,,	12·0	12·5	12·9	12·7	12·3	11·3	12·9	13·4
375	Dec. 5 ,,	11·0	10·1	11·7	10·0	9·9	11·3	10·8	12·1
376	Jan. 3, 1878	14·5	12·4	11·3	12·4	13·1	13·0	11·2	12·5
377	Feb. 2 ,,	14·1	11·9	14·4	14·2	15·0	14·3	13·0	12·3
378	Mar. 4 ,,	11·9	11·9	11·5	11·0	11·2	11·4	11·2	10·7
(379)	April 3 ,,	10·8	11·5	10·5	11·1	12·3	10·8	9·7	9·8
(380)	May 2 ,,	9·9	9·2	9·3	10·1	9·6	9·3	9·1	8·9
(381)	June 1 ,,	8·7	8·8	9·2	8·8	9·8	8·4	8·6	6·9
(382)	June 30 ,,	4·5	5·6	7·0	6·8	7·5	7·9	7·2	6·1
(383)	July 30 ,,	5·8	6·6	6·0	5·7	4·8	6·0	6·4	7·2
(384)	Aug. 28 ,,	7·8	8·4	7·7	6·5	7·6	7·8	6·3	6·9
385	Sept. 26 ,,	8·0	10·1	10·3	9·6	10·5	10·4	9·5	9·4
386	Oct. 26 ,,	11·1	11·2	9·6	9·9	10·5	10·5	11·4	11·6
387	Nov. 24 ,,	11·2	11·1	12·4	14·4	14·4	14·9	15·3	14·8
388	Dec. 24 ,,	13·1	12·4	14·2	14·5	12·1	11·1	13·0	14·4
389	Jan. 22, 1879	15·3	15·6	14·5	13·8	12·8	13·6	12·5	11·7
390	Feb. 21 ,,	12·2	11·8	11·0	13·5	14·1	12·2	12·0	13·9
(391)	Mar. 23 ,,	12·5	11·9	12·2	10·5	10·6	11·6	11·7	11·0
(392)	April 21 ,,	10·8	9·9	8·8	9·6	10·4	9·7	8·8	8·0
(393)	May 21 ,,	9·4	10·2	7·3	6·6	7·1	7·7	8·6	9·2
(394)	June 20 ,,	7·4	5·8	5·3	5·3	6·6	6·5	6·2	7·1
(395)	July 19 ,,	7·6	8·1	7·8	6·7	5·3	4·9	5·8	5·6

No. of lunation.	Date of new moon beginning lunation.	(0).	(1).	(2).	(3).	(4).	(5).	(6).	(7).
(396)	Aug. 18, 1879	6·3°	5·9°	6·8°	7·7°	6·8°	7·1°	8·3°	8·7°
397	Sept. 16 ,,	8·4	7·9	7·5	7·5	7·8	7·0	7·3	9·1
398	Oct. 15 ,,	10·5	12·2	12·8	13·0	12·3	10·1	12·8	16·0
399	Nov. 14 ,,	14·7	13·8	13·5	14·6	16·6	15·1	13·6	15·0
400	Dec. 13 ,,	15·1	13·5	15·6	15·4	13·1	14·2	14·7	14·2
401	Jan. 12, 1880	13·4	13·8	12·6	15·6	17·6	15·0	13·1	12·9
402	Feb. 10 ,,	14·4	12·1	12·1	13·2	14·2	14·8	12·5	11·8
(403)	Mar. 11 ,,	11·3	11·5	10·4	9·4	10·9	12·3	12·5	11·5
(404)	April 9 ,,	10·0	8·8	9·9	10·6	10·1	9·7	9·9	10·0
(405)	May 9 ,,	9·5	9·1	9·3	9·3	9·0	8·4	7·9	9·1
(406)	June 8 ,,	9·0	7·9	7·5	7·8	8·7	8·2	6·6	6·6
(407)	July 7 ,,	7·1	6·9	6·0	7·3	6·9	6·6	6·6	7·1
(408)	Aug. 6 ,,	6·5	6·2	6·5	6·8	8·0	8·4	7·9	7·3
(409)	Sept. 4 ,,	7·1	8·3	9·0	6·6	6·2	7·4	7·1	7·7

8. The whole series of 409 lunations gives the following result:—

Phase of lunation..................	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Value of range......................	10·69	10·67	10·67	10·73	10·77	10·66	10·61	10·66	(A)

A series which, like that found by Dr. Stewart from the Kew temperature-ranges, has two maxima and two minima, but every turning-point in the Bombay series occurs somewhat later on in the lunation than the corresponding turning-point in the Kew series, and the range (0°·16) of the Bombay series is less than that (0°·46) of the Kew series. The sum of the four left-hand numbers (42·76) is also larger, as in the Kew series, than the sum (42·70) of the four right-hand numbers. Series (A) is curved in fig. 2.

Dividing the whole series into two parts, we obtain—

Phase of lunation..................	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Range (1847·75 to 1863·75) ...	11·32	11·36	11·42	11·53	11·49	11·32	11·30	11·25	(B)
,, (1863·75 to 1880·75) ...	10·10	10·01	9·96	9·98	10·10	10·05	9·96	10·11	(C)

Upon which it may be remarked that, though possessing, of necessity, points of similarity to the series (A), these two series are far from being identical with it or with each other.

D. *Semi-annual Lunar Variation.*

9. In dividing the lunations into winter and summer lunations, we had inadvertently chosen the 21st March and 23rd September, instead of the 31st March and 30th September, as the dates between which,

if the middle of a lunation occurred, the lunation should be considered a summer lunation, and the serial numbers of such lunations in Table III are enclosed in parentheses to distinguish them from the others, which are to be considered as those of winter lunations. The average date of new moon will be about the 22nd of each month, and, accordingly, in eliminating the residual effect of the annual variation upon the lunar variations for the winter and summer half-years, the beginnings of the several months have been taken to correspond with the average time of first quarter of the moon, and the respective half-years have been made to commence after the lapse of three-quarters of the months of September and March. The numbers at the foot of Table Ia having been curved on a large scale, the ordinates of the curve were measured for every eighth of a month, and the averages were taken of the six sets of eight numbers corresponding to the winter lunations, and of the six sets corresponding to the summer lunations. These were then multiplied by 1·069, the ratio of the average scale of the 409 lunations to the scale of the period 1873 to 1880 (that is, of Table Ia), and the variations were then taken—with the results that will now be made use of.

The values of temperature-range found for the eight phases of the winter lunations, of which there are 199, are—

Phase of lunation	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Mean range	12·50	12·54	12·73	12·89	13·00	12·92	12·91	13·02	(D)
Correction applicable to winter months......................	+ ·33	+ ·25	+ ·13	− ·01	− ·09	− ·15	− ·20	− ·24	(E)
Correct value of winter lunar range	12·83	12·79	12·86	12·88	12·91	12·77	12·71	12·78	(F)

and for the eight phases of the summer lunations, of which there are 210, they are—

Phase of lunation	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Mean range	8·98	8·89	8·72	8·69	8·66	8·52	8·42	8·43	(G)
Correction applicable to summer months	− ·30	− ·21	− ·12	− ·04	+ ·04	+ ·12	+ ·20	+ ·27	(H)
Correct value of summer lunar range	8·68	8·68	8·60	8·65	8·70	8·64	8·62	8·70	(I)

Fig. 3 represents the corrected variation for the summer months, and fig. 4 for the winter months. The winter curve, like that of Kew, is mainly a single period curve, and its maximum and minimum phases both occur somewhat later than at Kew. The summer curve is of smaller range; again, like the corresponding curve at Kew, but unlike the latter, it is a very regular double period curve.

10. The excesses of the two series (F) and (I) above the series (A), that is, the semi-annual inequalities of the lunar variations, are—

Phase of lunation	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Winter inequality	+2·14	+2·12	+2·19	+2·15	+2·14	+2·11	+2·10	+2·12	(J)
Summer inequality	−2·01	−1·99	−2·07	−2·08	−2·07	−2·02	−1·99	−1·96	(K)

Curves representing the series (K) and (J) form figs. 7 and 8 respectively, and they are, necessarily, nearly opposite to each other in character, and, like those of Kew, they are in the main single period waves, but with the maximum and minimum phases occurring later at Bombay than at Kew.

11. The next two series (L) and (M) are the winter lunar variations for the periods 1847·75 to 1863·25 (sixteen winters), and 1863·75 to 1880·25 (seventeen winters) obtained in the same manner as series (F). They are curved in figs. 5 and 6, which though possessing little likeness to each other, have, of course, each points of similarity with fig. 4.

Phase of lunation		(0)	(1)	(2)	(3)	(4)	(5)	(6	(7)	
Winter lunar variation.	First 16 years	13·43	13·58	13·69	13·79	13·62	13·43	13·46	13·36	(L)
	Last 17 years	12·26	12·03	12·06	12·01	12·23	12·15	12·00	12·23	(M)

It may be noted that the series (L) and (M) bear nearly the same relation to the series (F) that the series (B) and (C) respectively bear to the series (A), a fact which, combined with the knowledge that the summer lunar variation is of small extent, implies that the winter months contribute nearly the whole of the irregularity which distinguishes one half of the period of thirty-three years from the other.

E. *Possible Variation of the Lunar Effect with the Sun-spot Period.*

12. In order to examine the relation of the winter lunar variation to the sun-spot period, the winters chosen as corresponding to the minimum and maximum respectively, of solar activity, are 1854–55 to 1856–57, 1861–62 to 1866–67, 1872–73 to 1874–75, and 1857–58 to 1860–61, 1867–68 to 1871–72. These groups of winters give results as follows :—

Phase of lunation	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Winter variation (minimum period) corrected for (E)	12·90	12·67	12·49	12·35	12·54	12·62	12·71	12·89	
Deduct (F)	12·83	12·79	12·86	12·88	12·91	12·77	12·71	12·78	
Supposed effect of solar minimum	+ ·07	− ·12	− ·37	− ·53	− ·37	− ·15	·00	+ ·11	(N)

and

Phase of lunation	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Winter variation (maximum period) corrected for (E)......	12·14	12·35	12·51	12·31	12·44	12·22	12·04	12·15	
Deduct (F)...........................	12·83	12·79	12·86	12·88	12·91	12·77	12·71	12·78	
Supposed effect of solar maximum	−·69	−·44	−·35	−·57	−·47	−·55	−·67	−·63	(P)

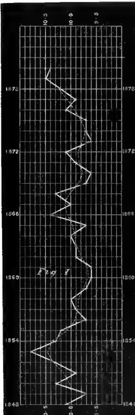
13. For the sake of comparability with Dr. Stewart's results for Kew, which may possibly refer to winters a year later in every case than those named above, we have repeated these calculations on that supposition, and have obtained, in lieu of series (N) and (P) the following:—

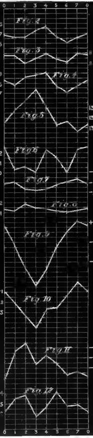
Phase of lunation	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Supposed effect of solar minimum	−·10	−·21	−·34	−·45	−·27	−·25	−·12	·00	(N′)
Supposed effect of solar maximum	−·58	−·44	−·41	−·63	−·53	−·38	−·52	−·51	(P′)

The series (N), (N′), (P), (P′) are curved in figs. 9 to 12. Contrary to the Kew series, they show that the temperature-range is somewhat less when sun-spots are excessive than when they are defective, the mean values of the several series being −·17, −·21, −·54 and −·50 respectively. Figs. 9 and 10 are much alike, and imply that the general winter lunar variation found in this way is subject to a pronounced change of character during the time of deficient sun-spots, having superimposed upon it a variation of single period and of greater range than its own. This affords a partial explanation of the great difference between the curves of winter lunar variations for the first sixteen and last seventeen years (figs. 5 and 6), the latter period being made up of years of deficient sun-spots in greater degree than the former period.

"Sun-spots and Terrestrial Phenomena. II. On the Variations of the Daily Range of the Magnetic Declination, as recorded at the Colaba Observatory, Bombay." By CHARLES CHAMBERS, F.R.S., Superintendent. Received May 30. Read June 15, 1882.

The present, like the preceding, investigation is on the model of one by Dr. Balfour Stewart, dealing with similar records obtained at the


10·5
10·0
9·5
1878
1872
1866
1860
1854
1848
Fig. 1
10·5
10·0
9·5


0 1 2 3 4 5 6 7 0
Fig. 2
10·8
10·7
10·6
Fig. 3
8·7
8·6
Fig. 4
12·9
12·8
12·7
Fig. 5
13·6
13·5
13·4
Fig. 6
12·2
12·1
12·0
Fig. 7
-1·9
-2·0
-2·1
Fig. 8
+2·2
+2·1
Fig. 9
+1
-1
-3
Fig. 10
-1
-2
-3
Fig. 11
-4
-5
-6
Fig. 12
-4
-5
-6
0 1 2 3 4 5 6 7 0